Size-Dependent Optical and Electrochemical Energy Gaps Comparison of CdSe Nanolusters

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The size-dependent optical and electronic properties of semiconductor nanocrystals have made them the focus of much research including the designing of photovoltaic devices and photocatalysts. These properties occur as a result of the phenomenon called quantum confinement. To improve the device efficiency it is important to have a better understanding of their size dependent electrochemical properties. Herein we demonstrate for the first time, a comparison of the size dependent optical properties and electrochemical energy gaps of poly(ethylene glycol) thiolate-protected ultra-small CdSe nanoclusters. The electrochemical energy gaps for various sized nanoclusters were determined from cyclic and differential pulse voltammetry in organic solvent/electrolyte medium, where large, molecule-like HOMO-LUMO energy gaps were observed. It was also found that a significant amount of charging energy is involved in the electrochemical energy gap. The effect of the thickness of the surface-pasivating ligands on the HOMO-LUMO energy gap is demonstrated and a quantized double layer (QDL) charging model presented.

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